# INSTRUCTION MANUAL

# SD1010B

# CARRIER GENERATOR

CPC-1941

Spectral Dynamics

A Scientific-Atlanta Subsidiary

SERIAL 161

# INSTRUCTION MANUAL

# SD1010B

# CARRIER GENERATOR

CPC-1941

U. S. PATENT NO. 3.018.439

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MODEL SD1010B CARRIER GENERATOR

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# PREFACE

## RECEIVING INSPECTION PROCEDURE

The Model SD1010B Carrier Generator is shipped fully assembled, packed in a polystyrene case designed to protect it against all normal shipping hazards. Immediately upon receipt, inspect the exterior of the shipping case and note any visible damage. Keep all forms and invoices attached to the shipping case. Remove the instrument from the shipping case and test its functional operation in accordance with Section II of this manual. If shipping damage is apparent, file a claim with the carrier's claims agent and send a copy to Spectral Dynamics Corporation. Be sure to include the instrument name, model number, and serial number on all correspondence. Spectral Dynamics Corporation will advise the buyer what should be done; arrangements for repair or replacement will be made as applicable.

## WARRANTY POLICY

All Spectral Dynamics products are warranted against defects in materials and workmanship. This warranty applies for one year from the date of delivery, or, in the case of certain components listed in some of the operating manuals, for the specified period. We will repair or replace products which prove to be defective during the warranty period, providing the failure or damage has not been caused by misuse or abnormal operating conditions. Fuses and lamps are specifically excluded from warranty. If the malfunction or a portion thereof is determined by Spectral Dynamics Corporation to have been caused by misuse or abnormal conditions of operation, an estimate of cost to repair will be submitted to the purchaser for approval before beginning any repair work.

Liability under this warranty is limited to servicing and adjusting the instrument returned to the factory, with transportation charges prepaid by the purchaser. No other warranty is expressed or implied. We are not liable for consequential damages.

If any malfunction develops, notify Spectral Dynamics Corporation or its representative in your area, giving details of the problem, and the name, model and serial number of the equipment. Upon receipt of this information, service data or shipping instructions will be provided.

## RETURN SHIPMENT PROCEDURE

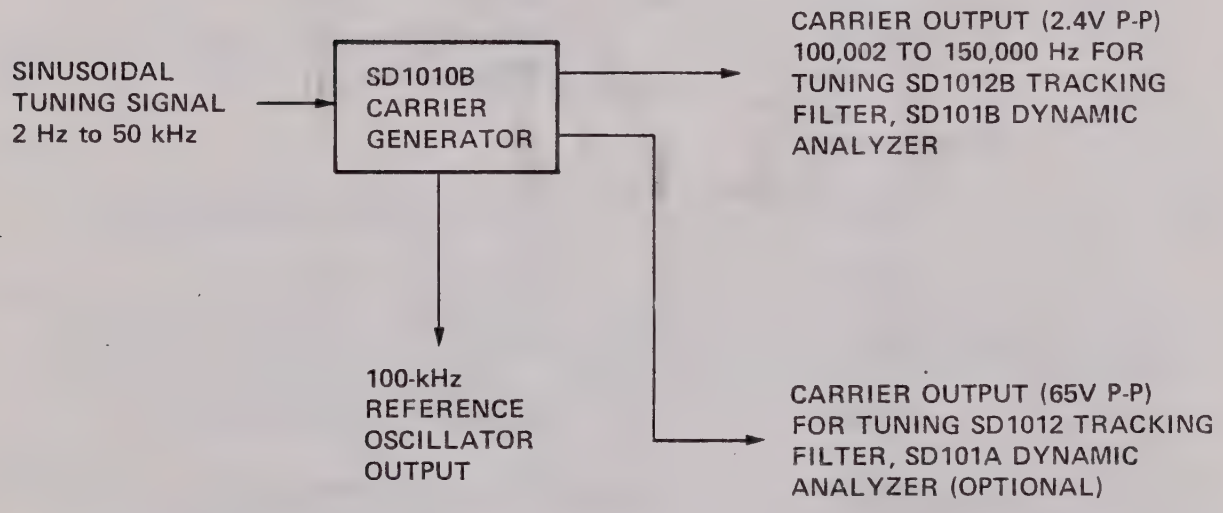
On receipt of shipping instructions, forward the instrument prepaid via air freight to the factory or authorized repair station indicated on the instructions. Replace the instrument in its original shipping case, or equivalent container.

# SECTION I

# GENERAL INFORMATION

## 1.1 INTRODUCTION

The Model SD1010B Carrier Generator is a solid-state instrument designed to provide the carrier tuning signal for multichannel tracking filters, such as the SD1012B, that use 100-kHz center-frequency filters.




The Model SD1010B accepts a sinusoidal tuning signal (2 Hz to 50 kHz) and produces a single-sideband carrier output of 100 kHz plus the input tuning frequency (100,002 to 150,000 Hz).

An optional 65V carrier output is available (Model SD1010B-1), making the SD1010B compatible with the SD1012, SD101AS, and SD101A (when used as a slave unit).

## 1.2 SPECIFICATIONS

### INPUT

| | |
|---|---|
| Tuning Frequency | 2 Hz to 50 kHz |
| Voltage Amplitude | 0.5V to 10 Vrms |
| Impedance | 70 kΩ shunted by 47 pF |

### OUTPUTS

| | |
|---|---|
| Carrier | 100 kHz + Tuning Frequency |
| * Amplitude | 2.4V p-p ±0.4V p-p into open circuit |
| Impedance | < 50 Ω, 3 mA maximum |
| CAL Carrier | 100,000-Hz plus line frequency signal output facilitated by front-panel switch |

100-kHz Reference

| | |
|---|---|
| * Amplitude | 7.25V p-p ±0.25V p-p into open circuit |
| Impedance | < 50 Ω, 3 mA maximum |

| | |
|---|---|
| 65V p-p Carrier | (Optional) |
| * Amplitude | 65V p-p ±5V p-p into open circuit |
| Impedance | < 50 Ω, 3 mA maximum |
| INPUT/OUTPUTS | All signal input/outputs connectors are BNC type located on rear-chassis panel |
| POWER | 105—125/210—250 Vac, 50-60 Hz at approximately 25W |

### DIMENSIONS

| | |
|---|---|
| Height | 5¼" (13,3 cm) |
| Width | 19" (48,3 cm) |
| Depth | 14" (35,6 cm) w/o connectors |
| Weight | 20 lbs (9,06 kg) |

*Revised (4-2-70)

## 1.3 FRONT PANEL FUNCTIONAL DESCRIPTION

Figure 1-1 illustrates the instrument front panel followed by a brief description of each of the front panel functions.

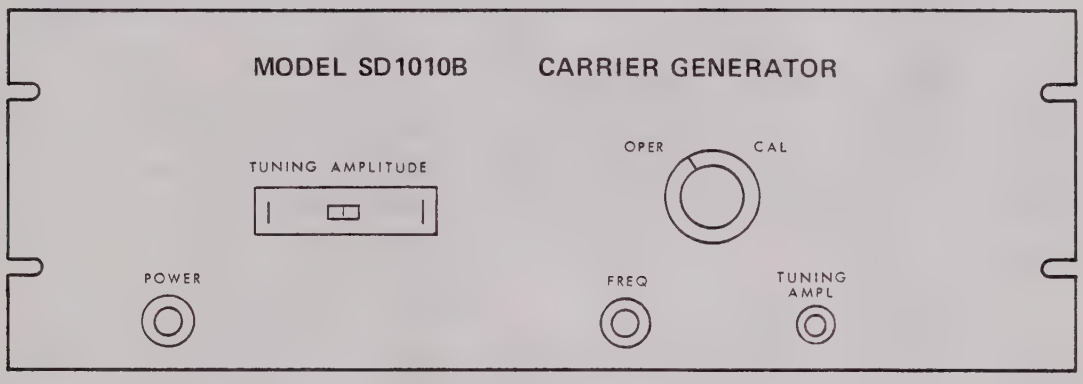



Figure 1-1. Front Panel

POWER

Push button type switch/indicator used to turn instrument on and off. Push button glows red when power is on.

TUNING AMPLITUDE Meter

Set to center of scale with TUNING AMPL control during operation with tuning signal applied; this setting prevents overloading the balanced modulators and indicates that the proper CARRIER OUTPUT level (2.4V) is present.

TUNING AMPL

Adjusted for center-scale reading on TUNING AMPLITUDE meter during operation with tuning signal applied (as described above).

FREQ

Facilitates varying slightly the 100-kHz reference oscillator frequency so carrier reference can be tuned to exact center frequency of filters used in tracking filter analyzers.

OPER/CAL

Set to OPER during normal operation. In CAL position, a calibrated line frequency signal replaces the tuning signal input; thus the CARRIER OUTPUT is 100 kHz plus the line frequency and is compatible with the calibration signal used in the associated system tracking filters.

## 1.4 REAR OF CHASSIS FUNCTIONAL DESCRIPTION

Figure 1-2 illustrates the rear of the instrument chassis followed by a brief description of each of the input/output functions.

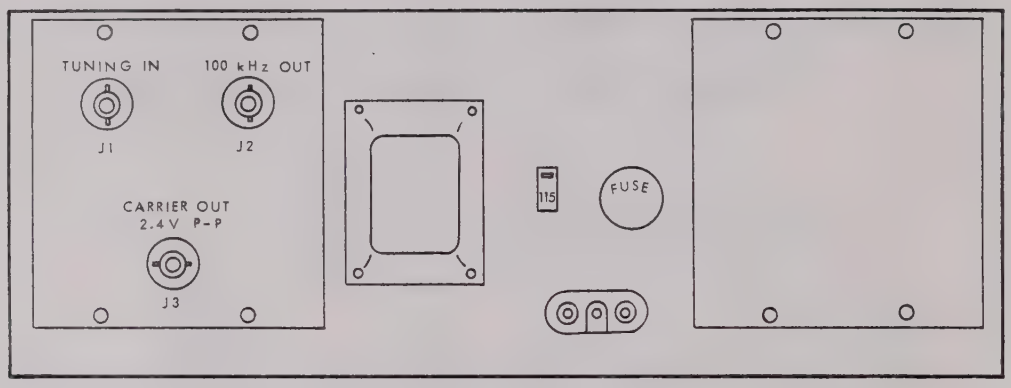



Figure 1-2. Rear of Chassis

TUNING IN

Accepts system tuning input signal over the frequency range of 2 Hz to 50 kHz.

100-kHz OUT

Provides a nominal 7.25V p-p signal at the 100-kHz reference signal frequency.

CARRIER OUT

Used for connecting the carrier output signal (100 kHz plus tuning frequency, at 2.4V ±0.4V p-p) to the system tracking filters; will drive up to 14-filter channels, i.e., seven Model SD1012B (two-channel) Tracking Filter units.

POWER IN

Accepts 3-wire plug and cable (supplied) for applying 115/230 Vac, 50-60 Hz primary input power. Center terminal is chassis ground. Uses Belden No. 17258 cable (as used on most Hewlett-Packard instruments, and obtainable from normal sources of HP parts).

115/230 Switch

Facilitates changeover of primary power input circuit for either 115V or 230V operation. Proper input power to be applied shows in window; screwdriver blade slot is up for 115V operation and down for 230V operation.

FUSE

Contains 3AG type, SLO-BLO fuse; ½A for 115V operation or ¼A for 230V operation.

# SECTION II

# OPERATION

## 2.1 GENERAL

The Model SD1010B Carrier Generator is designed to be used as an integral part of a multiple tracking filter system using units such as the Model SD1012B. Therefore the operator should refer to the applicable system instruction manual, which includes installation and operation instructions for the SD1010B. See also Figures 1-1 and 1-2 in Section I of this manual for the description and location of all operating controls, indicators and connectors.

## 2.2 OPERATIONAL CHECKOUT

Perform the following procedure to ensure that the instrument is functioning properly. An SD104A-5 Sweep Oscillator (or equivalent), a frequency counter, and an oscilloscope having 500-kHz bandwidth are required. The sweep oscillator must cover the frequency range from 5 Hz to 30 kHz with constant (±0.2 dB) sine wave output.

a. Check that the 115/230 switch on instrument rear panel is set to proper input line voltage.

b. Ensure power cord (Belden No. 17258 supplied) is connected between POWER IN receptacle on instrument rear panel and primary power receptacle.

c. Press POWER switch/indicator on front panel; it should glow red indicating power is on.

d. Allow the SD1010B to warm up for at least 5 minutes.

e. Set OPER/CAL switch to CAL.

f. Use oscilloscope and frequency counter, and check that the output at J2 (100-kHz OUT) is ≈7.25V p-p at 100-kHz. If necessary, adjust front-panel FREQ control for 100.000-kHz output.

g. Check that output at J3 (CARRIER OUT, 2.4V P-P) is ≈2.4V p-p at 100 kHz plus line frequency.

h. Set OPER/CAL switch to OPER.

i. Connect sweep oscillator constant-amplitude (minimum 0.5 Vrms) sine wave output to J1 (TUNING IN).

j. Adjust SD1010B front panel TUNING AMPL control for center-scale reading on TUNING AMPLITUDE meter.

k. Adjust sweep oscillator to sweep slowly from 5 Hz to 30 kHz, and observe that TUNING AMPLITUDE meter reads within the center-scale green area.

This concludes the operational checkout procedure. Remove power, disconnect test equipment, and place instrument in service.

## 2.3 SYSTEM OPERATION

It is assumed that the instrument is functioning properly in accordance with the operational check of paragraph 2.2, power is applied, and instrument is warmed up per system instructions. Also, the system tuning signal is applied to J1 (TUNING IN) and all interconnections are made between J3 (CARRIER OUT) and associated tracking filter units.

a. Adjust SD1010B TUNING AMPL control for center-scale reading on TUNING AMPLITUDE meter.

b. Adjust FREQ control as prescribed in the system instruction manual. Normally, the SD1010B and associated tracking filter/analyzer are placed in the CAL mode. Then using the narrowest bandwidth filter, adjust the FREQ control for peak reading on the tracking filter/analyzer meter.

## SECTION III

## CONCEPT AND THEORY OF OPERATION

### 3.1 CONCEPT OF OPERATION

The Model SD1010B utilizes the principles of operation of balanced modulators and the linear addition of their outputs to produce a single-sideband carrier signal. The input tuning signal frequency (f) is combined with a 100-kHz reference signal, and only the upper sideband (100 kHz + f) is extracted as the carrier output.

This technique is accomplished as follows:

> The sinusoidal input tuning signal (2 Hz to 50 kHz) is converted to two signals displaced by 90 degrees. The reference oscillator 100-kHz signal is also converted to two 100-kHz signals displaced by 90 degrees. A phase-shifted tuning signal and a properly phased 100-kHz signal are combined in each of two balanced modulators. The outputs of each balanced modulator (upper and lower sidebands) are linearly added; the lower sideband amplitudes are canceled. The sum of the upper sideband signals is extracted as the carrier output signal.

### 3.2 BLOCK DIAGRAM DESCRIPTION (See Figure 3-1.)

The constant-amplitude system tuning signal (2 Hz to 50 kHz) is applied to TUNING INPUT J1. To prevent circuit overloading and ensure proper carrier output signal level, the TUNING AMPL control is adjusted for center-scale reading on the TUNING AMPLITUDE meter. With the OPER/CAL switch set to OPER, the input signal is fed to the wideband phase shifter. This circuit provides two output signals equal in amplitude, but displaced in phase 90° with respect to each other. For purpose of explanation, these signals are referred to as the "0°" (upper) and "90°" (lower) tuning signals.

The 0° tuning signal is applied to a balanced modulator along with a 100-kHz reference signal generated by a crystal-controlled oscillator. The 90° tunning signal is applied to a balanced modulator along with the 100-kHz reference signal phase-shifted by 90°. The outputs of the balanced modulators, each containing the upper and lower sidebands, are linearly combined. Because the two signals are equal in amplitude but are displaced in phase by 90 degrees, their linear addition results in the lower sideband amplitudes canceling and the upper sideband amplitudes adding.

The upper sideband signal (100 kHz + tuning frequency) is selected and amplified by a 100-kHz to 150-kHz bandpass amplifier. This amplifier provides meter drive current for the TUNING AMPLITUDE meter, and also drives the carrier filter. This circuit filters any extraneous signals and produces a 2.4V ±0.4V p-p sine wave output at the CARRIER OUT connector.

With the OPER/CAL switch set to CAL, the TUNING INPUT signal is replaced by an a-c signal at the power line frequency (from the power supply), making the CARRIER OUTPUT frequency compatible with the signal used for calibrating the tracking filter analyzers.

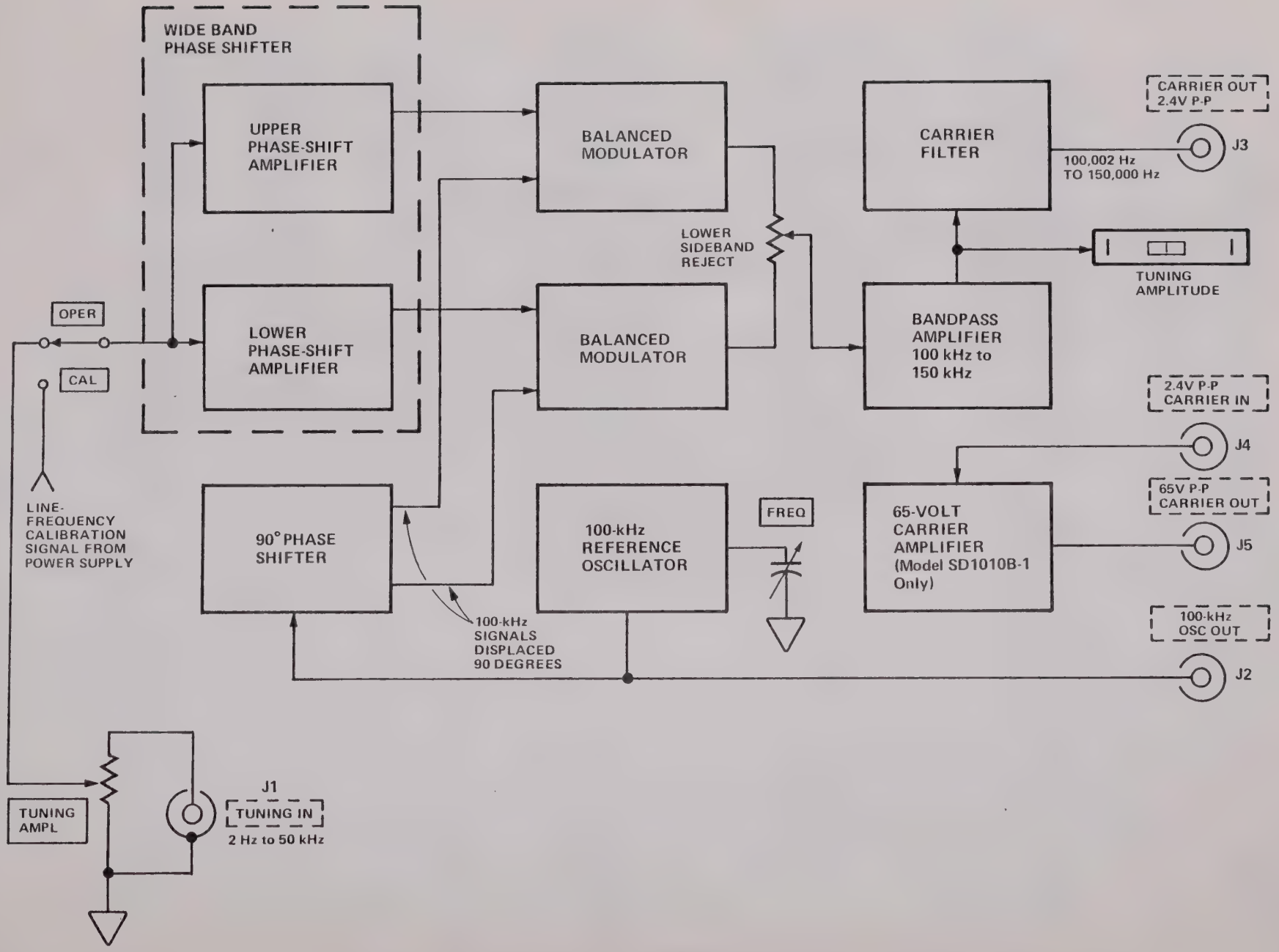



Figure 3-1. Simplified Block Diagram of Model SD1010B Carrier Generator

A front-panel screwdriver adjust FREQ control is provided for precisely tuning the 100-kHz reference oscillator to the center frequency of the filters used in the system.

All circuit d-c operating voltages are supplied by an integral power supply capable of operation from 115V or 230V a-c primary power; this feature is switch selectable on the rear-chassis panel.

A 65V carrier amplifier circuit card is available as an optional factory installed assembly, along with its input/output connectors and jumper cable. It accepts the 2.4V CARRIER OUT signal and provides a 65V p-p signal as required by the SD101AS, SD1012, and SD101A (when used as a slave unit).

## 3.3 THEORY OF OPERATION

Throughout the following circuit description, refer to schematic DWG. NO. 11300 located at the back of this manual. Parts are referenced by their circuit card number and alphanumeric designation. For example, on wide-band phase shifter circuit card A5, capacitor C6 is referred to as A5C6. Parts mounted on the chassis panels, and between circuit cards are referenced by their alphanumeric designation only.

### 3.3.1 Input Circuit

The sinusoidal TUNING INPUT signal (2 Hz to 50 kHz) connected to J1 is impressed across TUNING AMPL control R4. This front-panel screwdriver-adjustable potentiometer is adjusted for a center-scale reading on the TUNING AMPLITUDE meter (with 0.5 to 10V tuning signal applied). With OPER/CAL switch S2A set to OPER, S2A-W1 selects the adjusted tuning signal from R4 and applies it to input terminal A5-A on wide-band phase shifter circuit card A5. With S2A set to CAL, S2A-W1 selects a 0.85V p-p sinusoidal calibration signal supplied by power supply circuit card A2. S2A-W2 completes the circuit between A2-22 and A2-W to apply +15V operating voltage to the calibration voltage circuitry on circuit card A2.

### 3.3.2 Wide-Band Phase Shifter (A5)

The wide-band phase shifter accepts the sinusoidal tuning signal (2 Hz to 50 kHz) and produces two outputs that are equal in amplitude but displaced by 90 degrees over the operating frequency range. As shown in Figure 3-2, the tuning signal is applied to two phase shift networks, "upper" and "lower". Each network consists of a combination of half-lattice all-pass sections which produce a relatively smooth phase-shift-versus-frequency curve over the operating range. (See graph of Figure 3-2.)

The "upper" network shifts the tuning signal phase $\phi 1$ degrees; the "lower" network, $\phi 2$ degrees. As shown on the graph, at any frequency along the phase shift curves, $\phi 1$ and $\phi 2$ are 90 degrees apart.

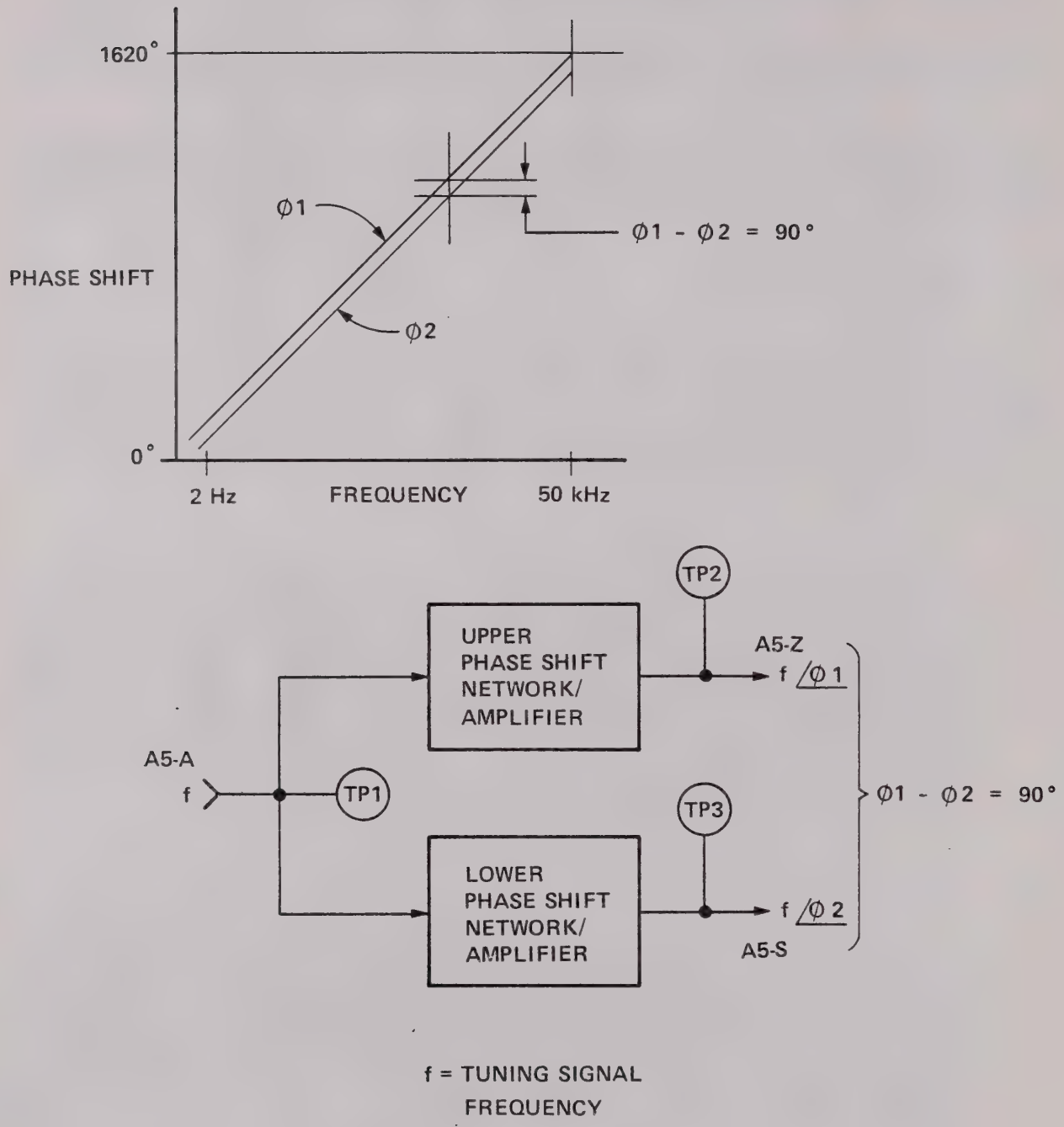



Figure 3-2. Wide-Band Phase Shifter Analysis

The input at A5-A is applied to the base of emitter follower A5Q2. The output of A5Q2 feeds both the "upper" and the "lower" phase shift networks. These networks operate similarly; slight differences in circuit parts values provide the required 90-degree phase displacement between their outputs. Potentiometers A5R8 and A5R15 in the "lower" network and A5R58 in the "upper" network provide phase adjustment at the low and high frequency ends respectively of the operating range.

The "upper" network output is buffered by emitter follower A5Q20 and routed to A5-Z; the "lower" output is buffered by emitter follower A5Q21 and routed to A5-S.

### 3.3.3 100-kHz Oscillator (A3)

This circuit card provides the 100-kHz reference signal for the balanced modulators on single-sideband output card A4. It also provides a nominal 7.25V p-p reference output signal at J2, 100-kHz OUT connector, for external use.

A3Q2 and -Q3 operate as a Butler oscillator with temperature-controlled crystal Y1 providing the feedback at 100 kHz. The front-panel FREQ ADJUST (C3) facilitates varying slightly the crystal oscillator frequency so that the carrier reference can be tuned to exact center frequency of the filters used in the external system tracking filter/analyzers.

A3Q4 and -Q5 are 100-kHz tuned voltage amplifiers, followed by buffer amplifier A3Q6. A3Q6 provides 8V p-p ±0.25V p-p reference signal to the single-sideband output card. Further buffering is provided by A3Q1 which supplies a nominal 7.25V p-p, at the reference frequency, to 100-kHz OUT connector J2.

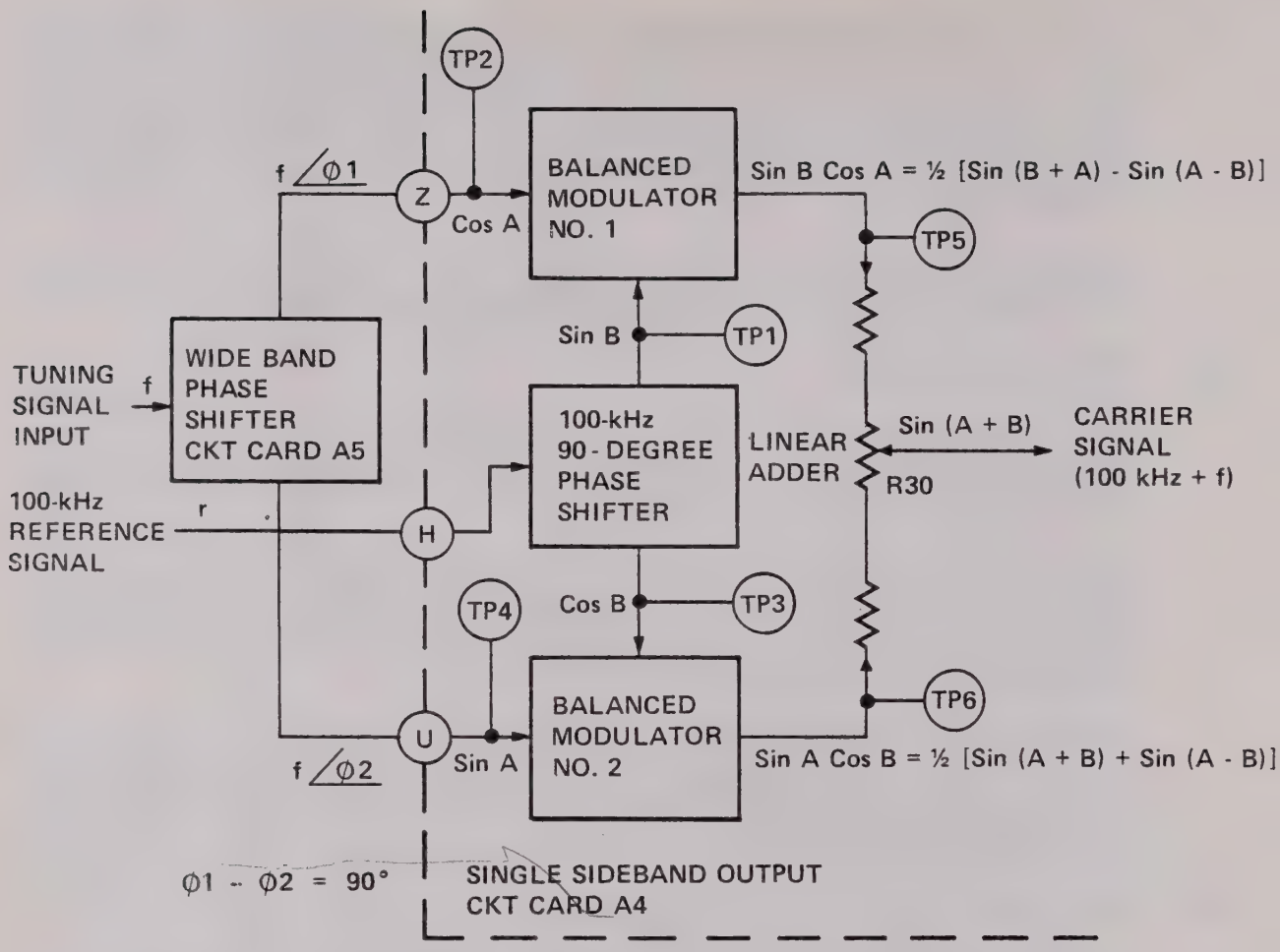
### 3.3.4 Single-Sideband Output (A4)

This circuit card contains the 100-kHz 90-degrees phase shifter, two balanced modulators, and a tuned 100—150-kHz bandpass amplifier. It accepts the two 90-degree phase shifted tuning signals and a 100-kHz reference signal, and produces a single-sideband (upper sideband) signal of 100-kHz plus the tuning frequency.

#### 3.3.4.1 100-kHz 90-Degree Phase Shifter

This circuit accepts the 100-kHz reference signal (A4-H) and produces two 100-kHz signals, displaced by 90 degrees, for driving the balanced modulators. The 90-degree phase shifter comprises A4Q1, -Q2, -Q3 and associated circuitry.

A4Q1 provides two 100-kHz signals displaced by 180 degrees. These two signals are applied across a phase shift network comprising A4C4, -R7 and -R8. The resultant two 100-kHz signals displaced by 90 degrees are buffered by emitter followers A4Q2 and A4Q3, and then routed to the balanced modulators. Potentiometer A4R8 (lower sideband null) provides phase shift adjustment.




Let: $\omega_f t = A$

$\omega_r t = B$

Where: $\omega_f$ = tuning frequency in radians/second

$\omega_r$ = reference frequency (100 kHz) in radians/second

Figure 3-3. Carrier Signal Generation Analysis

### 3.3.4.2 Balanced Modulators and Linear Adder

The balanced modulators combine the 90-degree phase shifted tuning signals with the 100-kHz reference signal. Then by linear addition of their outputs, the upper sideband (100-kHz plus tuning frequency) is extracted as the carrier output signal. Two significant principles of operation involved here are as follows:

1) The output of a balanced modulator contains only the upper and lower sidebands of its two input signals.

2) One modulator is fed by a pair of signals that correspond to the other modulator's input signals but are each displaced by 90 degrees. Then by linear addition of the outputs from both modulators, the lower sideband amplitudes cancel each other and the upper sideband amplitudes are summed.

A simplified block diagram including the mathematical analysis of the carrier signal generation is shown in Figure 3-3.

### 3.3.4.3 Bandpass Amplifier

This is a 5-stage amplifier with three tuned stages adjusted to pass only signals in the frequency range of 100 kHz to 150 kHz.

The carrier output signal (100,002 to 150,000 Hz) is extracted at the summing point of the linear adder (wiper of A4R30) and amplified by A4Q4. The setting of potentiometer A4R35 determines the gain of A4Q4 and the gain of the center frequency (122 kHz) of the bandpass amplifier. The output of A4Q4 is amplified by A4Q5.

The following three stages (A4Q5, -Q6, and -Q8) operate as tuned frequency voltage amplifiers. Potentiometers A4R37 (A4Q5 collector) and A4R49 (A4Q8 collector) facilitate bandwidth adjustment at the low and high ends respectively of the passband. The output of A4Q8 is buffered by emitter follower A4Q9 and then routed through A4-K to A6-U of the carrier filter circuit card. With a constant amplitude TUNING SIGNAL input, the carrier output level at A4TP9 (A4-K) is 2.4V p-p ±0.4V p-p.

### 3.3.4.4 TUNING AMPLITUDE Meter Circuit

A portion of the carrier output signal at A4TP9 is fed to diode rectifier A4CR9 and A4Q7. The emitter current of A4Q7 is proportional to the carrier amplitude. Potentiometer A4R48 facilitates meter current adjustment during calibration of the instrument.

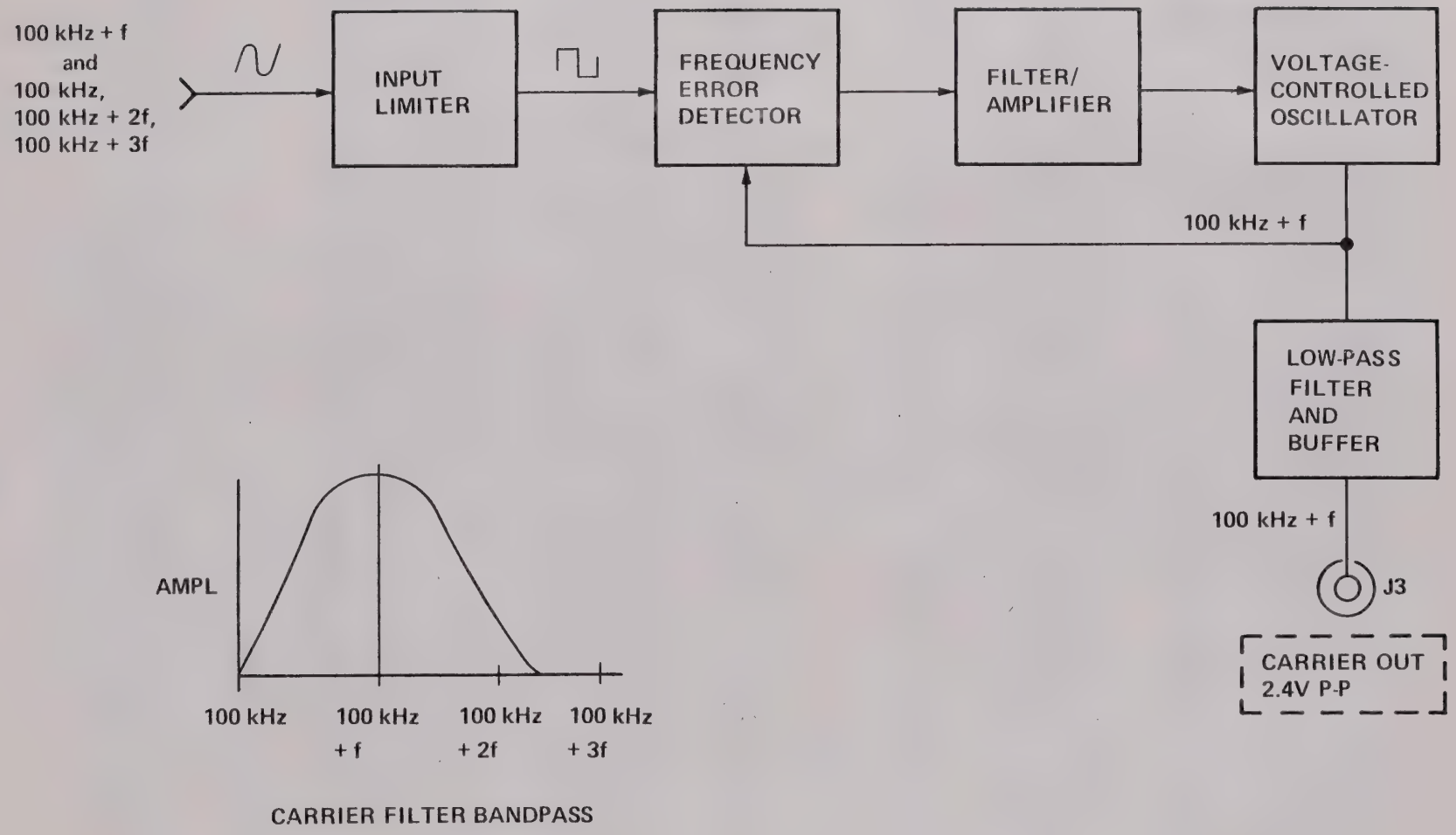



Figure 3-4. Simplified Block Diagram of Carrier Filter

### 3.3.5 Carrier Filter (A6)

The carrier filter accepts the unfiltered carrier signal (100 kHz + tuning frequency) from the single-sideband output card. It filters any extraneous signals such as the 100-kHz reference, lower sideband, and signals that are harmonically related to the tuning frequency. The filtered carrier signal (100,002 to 150,000 Hz at 2.4V p-p) is provided at rear chassis connector J3, CARRIER OUT 2.4V P-P.

The input limiter converts the unfiltered sinusoidal carrier signal to a square wave. (See Figure 3-4.) This signal is applied as one of the two inputs to the frequency error detector. The second input is provided by the VCO (voltage-controlled oscillator). Any difference in frequency between these two inputs produces an error signal. The detected error signal is filtered and amplified. The correction voltage developed is applied to the VCO in proper polarity to cause the VCO frequency to equal the carrier signal input frequency. The VCO output (100 kHz + f) is filtered, buffered, and routed to rear chassis connector J3.

### 3.3.6 Power Supply (A2)

Power supply circuit card A2, supplied by transformer T1, provides all circuit d-c operating voltages (+15V and -15V). It also provides the 0.85V p-p sinusoidal calibration signal. A +45V regulated supply is also included on the card; it is used by the 65V carrier amplifier in the Model SD1010B-1.

The primary power input applied at POWER IN connector J6 pin 3, is routed through fuse F1, contacts 1 and 2 of POWER switch/indicator S3, to T1 primary. The setting of switch S3 connects the T1 primary windings in parallel for 115 volt operation or in series for 230 volt operation. An additional high-voltage winding is provided to supply the optional 65V Carrier Amplifier when used.

Both the -15V and +15V supplies use conventional solid-state diode rectification and electronic voltage regulation circuitry. However, note that the regulation of the +15V supply is slaved to the -15V output via resistors A2R10 and A2R13. This configuration causes the two supplies to track each other; i.e., their outputs, although opposite in polarity, are always equal in amplitude.

The sinusoidal calibration voltage (line frequency) is developed by A2Q8, A2Q13, and associated circuitry. With OPER/CAL switch set to CAL, this circuit is activated. A square wave is developed at the A2Q8 collector. (The square wave output at A2TP8 and A2-N is not used in the Model SD1010B). The output of A2Q8 is filtered (converted to a sine wave) and then amplified by A2Q13. The output of A2Q13 is adjusted by A2R35 to provide 0.85V p-p at A2-22. This signal is routed to S2A-W1 CAL for use as the tuning input signal during system calibration.

# SECTION IV

# CALIBRATION AND MAINTENANCE

## 4.1 GENERAL

Before calibrating the instrument, the technician is advised to study carefully Section III of this manual. Refer also to the front-panel and rear-chassis descriptions given in Section I.

Most voltage checks and adjustments can be made with the circuit cards installed. Remove and extend cards only when directed, and then use caution when installing extender and circuit card; be sure to remove power. Figure 4-1 is a top view of the instrument with cover removed, showing all calibration controls.

Note that except for the extender card, each circuit card is individually keyed to its receptacle. Each card is slotted, and a "key" is located between two pins of each receptacle. Therefore, the "key" must be removed before the extender can be inserted.

NOTE

A layout drawing showing the location of the circuit cards is located on the inside surface of the top cover. On this drawing, the location of each circuit card "key" is denoted by its two adjacent pin numbers. For example, on circuit card A1, the "key" is located between pins 6 and 7.

CAUTION

To prevent possibility of plugging a circuit card in the wrong socket, be sure to replace "keys" after calibration or servicing the instrument.

Throughout the calibration procedure, calibration controls and parts on a circuit card are referenced by their circuit card and part number alphanumeric designator. For example, on Power Supply circuit card A2, R15 is referred to as A2R15. Similarly, circuit card pin connections are referenced by the circuit card alphanumeric designator, a hyphen, pin number/letter; such as A5-A, or A2-22.

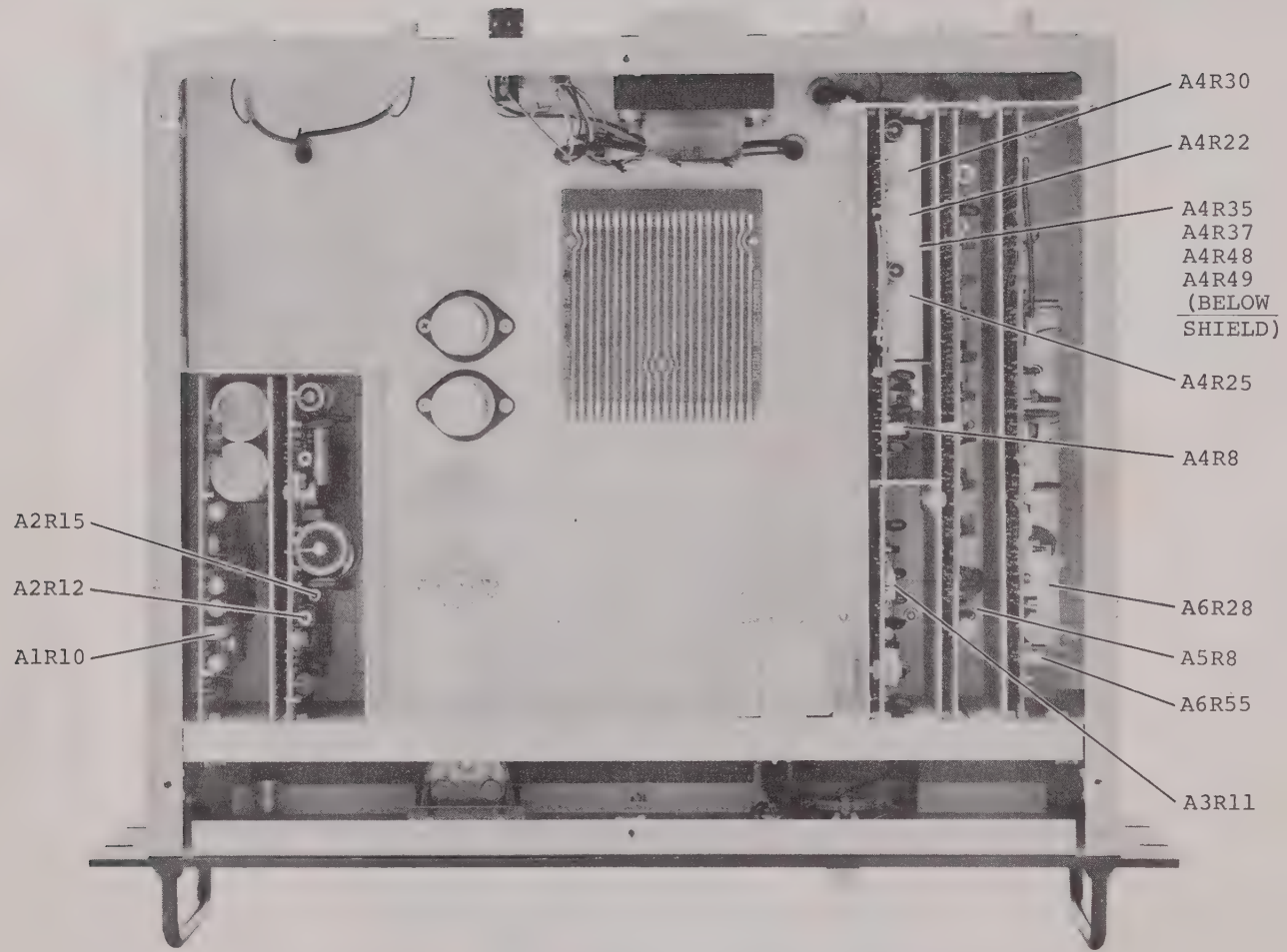



Figure 4-1. Top Chassis View

## 4.2 CALIBRATION PROCEDURE

### CAUTIONS

1) To ensure proper calibration of the instrument, the following procedure must be performed in its entirety and in the sequence listed.

2) Be sure power is off before removing or replacing circuit cards.

Table 4-1 lists the test equipment required; test equipment having equal or better operational characteristics may be substituted.

Table 4-1. Test Equipment Required

| Name | Model No. | Manufacturer |
|---|---|---|
| Distortion Analyzer | 331A | Hewlett-Packard |
| Frequency Counter | 5223L | Hewlett-Packard |
| Oscilloscope w/Matched Probes | 503 | Tektronix |
| Oscilloscope | 545 | Tektronix |
| Probe | 013-071 | Tektronix |
| Phase Meter | SD110 | Spectral Dynamics |
| Sweep Oscillator | SD104A | Spectral Dynamics |
| Digital Voltmeter | 3440 | Hewlett-Packard |
| RMS Voltmeter | 202C | Hewlett-Packard |
| Volt-Ohmmeter | 269 | Simpson |
| Wave Analyzer | 310 | Hewlett-Packard |

### 4.2.1 Preliminary Setup

a. With the power off, check that the front-panel TUNING AMPLITUDE meter is at mechanical zero; i.e., needle resting over the left-hand vertical line. If necessary, remove the instrument top cover and mechanically adjust meter.

b. Check that the 115/230 switch on the rear chassis is set properly and the correct fuse value is installed.

c. Connect power cord to the primary power source, and press the front-panel POWER switch/indicator; it should glow red indicating power is on.

d. Allow a 5-minute warmup and then remove instrument top cover (if not previously removed).

### 4.2.2 Power Supply (A2)

a. Connect DVM and oscilloscope to A2TP4. Adjust A2R15 for -15V (-14.980 to -15.020V). Ripple should be less than 4 mV p-p.

b. Connect DVM and oscilloscope to A2TP3. Adjust A2R12 for +15V (+14.980 to +15.020V). Ripple should be less than 4 mV p-p.

c. Connect DVM and oscilloscope to A2TP9. DVM should read approximately +45V; ripple should be less than 5 mV p-p.

### 4.2.3 Wide Band Phase Shifter (A5)

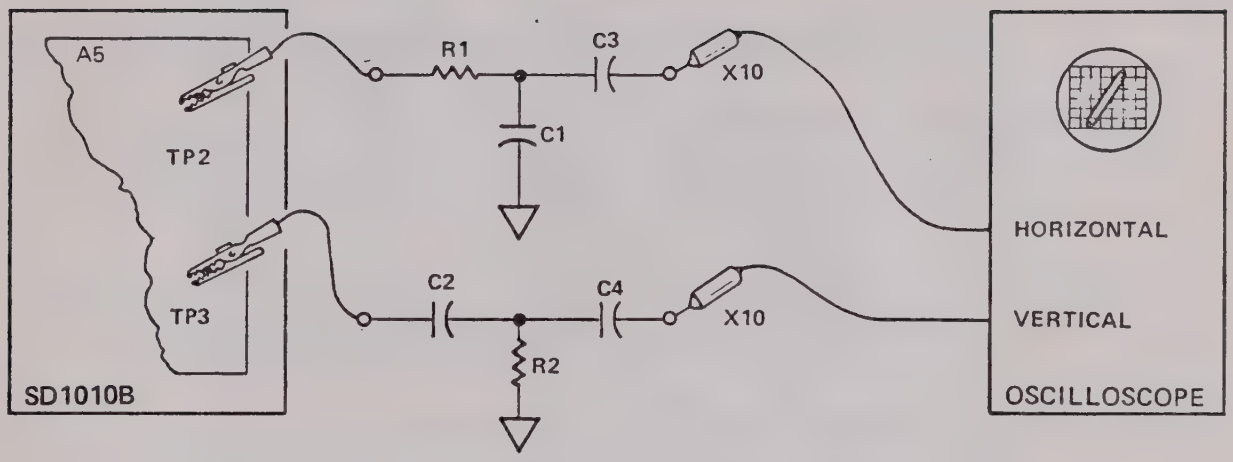
**NOTE**

**Perform this procedure only if components have been replaced, or if frequency response is out of specification.**

a. Remove power, extend card A5 (save "key"), and re-apply power.

b. Set OPER/CAL switch to OPER.

c. Apply sweep oscillator sine wave output to J1, TUNING IN. Adjust oscillator output for approximately 1 Vrms at 400 Hz. On SD1010B, adjust TUNING AMPL control for center-line (green area) reading on TUNING AMPLITUDE meter.




$R_1$, $R_2$: 78.7k, 1%, matched within 0.1%. ($|R_1-R_2| \leq 800\Omega$)
$C_1$, $C_2$: 4 $\mu$F, 5%, matched within 0.5%. ($|C_1-C_2| \leq 0.02$ $\mu$F)
$C_3$, $C_4$: 10 $\mu$F, 10%, mylar.

Figure 4-2. Low Frequency Phase Calibration Setup for Wide Band Phase Shifter

d. Connect oscilloscope to A5TP2 and then A5TP3, and measure approximately 0.8V p-p at each point.

* e. Connect oscilloscope (Tektronix 503) between A5TP2 and A5TP3 as shown in Figure 4-2.

f. Adjust oscillator for 2 Hz ±0.2 Hz (0.5s ±0.05s).

g. Adjust A5R15 for best straight line Lissajous pattern on oscilloscope. Measure phase shift as shown in Figure 4-3.

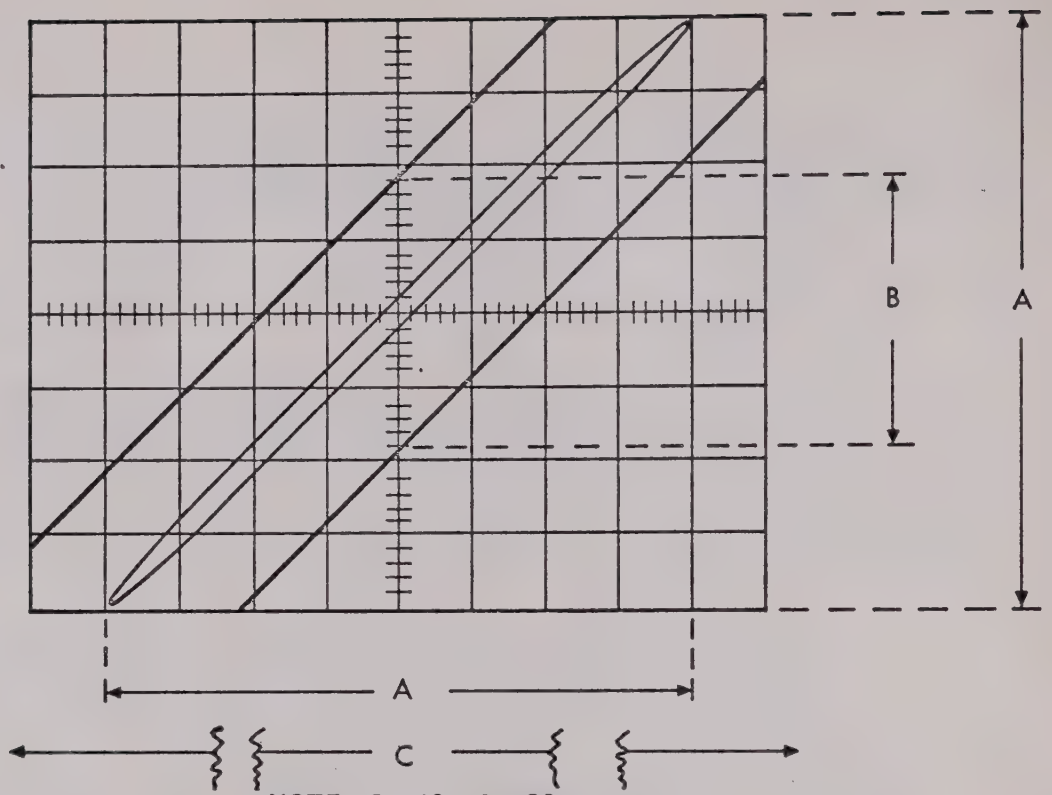
h. Adjust oscillator for 1 Hz ±0.1 Hz (1s ±0.1s).

i. Adjust A5R8 for best straight line Lissajous pattern on oscilloscope.

j. Repeat steps f. through i. until phase shift cannot be reduced further. The phase difference should not be greater than 0.5 degrees at 2 Hz, and not greater than 2 degrees at 1 Hz.

k. Disconnect setup shown in Figure 4-2, and connect phase meter (SD110) directly to A5TP2 and A5TP3.

*Revised (11-30-70)




NOTE: C = 10 x A = 80

(1) Apply signals to oscilloscope horiz. and vert. input preamps.

(2) Adjust horiz. and vert. gain controls so Lissajous pattern is diagonally enclosed within 8-cm by 8-cm area (A by A').

(3) Increase both horiz. and vert. gain by factor of 10.

(4) Measure dimension B in cm, and compute Ratio C/B as follows: Because C = 8 x 10 = 80, Ratio C/B = 80/B.

(5) Determine phase shift using table below.

| C/B | DEG | C/B | DEG | C/B | DEG | C/B | DEG |
|---|---|---|---|---|---|---|---|
| 810.165 | .1 | 73.6559 | 1.1 | 38.5879 | 2.1 | 26.1471 | 3.1 |
| 405.084 | .2 | 67.5187 | 1.2 | 36.8348 | 2.2 | 25.3308 | 3.2 |
| 270.056 | .3 | 62.3258 | 1.3 | 35.234 | 2.3 | 24.564 | 3.3 |
| 202.543 | .4 | 57.8747 | 1.4 | 33.7668 | 2.4 | 23.8424 | 3.4 |
| 162.035 | .5 | 54.0172 | 1.5 | 32.4169 | 2.5 | 23.162 | 3.5 |
| 135.03 | .6 | 50.6419 | 1.6 | 31.1709 | 2.6 | 22.5194 | 3.6 |
| 115.741 | .7 | 47.6638 | 1.7 | 30.0172 | 2.7 | 21.9116 | 3.7 |
| 101.274 | .8 | 45.0166 | 1.8 | 28.946 | 2.8 | 21.3358 | 3.8 |
| 90.0221 | .9 | 42.6481 | 1.9 | 27.9487 | 2.9 | 20.7895 | 3.9 |
| 81.0207 | 1.0 | 40.5165 | 2.0 | 27.0179 | 3.0 | 20.2706 | 4.0 |

Figure 4-3. Measuring Phase Shift with an Oscilloscope

*Revised (11-30-70)

*l. Adjust oscillator for 40 kHz ±500 Hz.

m. Adjust A5R58 for 90 degrees (89.5 to 90.5 degrees) phase meter reading.

n. Sweep oscillator slowly from 10 Hz to 50 kHz; phase meter reading should not vary from 90 degrees by more than 1.5 degrees from 10 Hz to 20 kHz, and ±3 degrees from 10 Hz to 50 kHz.

o. Repeat steps l. through n. as necessary to correct for any interaction, and for as close as 90 degrees phase difference between A5TP2 and A5TP3 as possible.

p. Remove power, remove card A5 and extender, replace "key" between pins 2 and 3, and return card A5 to its socket. Extend card A3 (save "key"), and re-apply power.

4.2.4 100-kHz Oscillator (A3)

a. Connect frequency counter to A3TP3 and GND, and adjust front-panel FREQ control for 100 kHz.

b. Connect oscilloscope to A3TP3 and GND, and adjust A3R11 (100-kHz AMPL ADJ) for 8V p-p (7.8V to 8.2V p-p).

c. Remove power, remove card A3 and extender, replace "key" between pins 7 and 8, and return card A3 to its socket.

Extend card A4 (save "key"), and re-apply power.

4.2.5 Single Sideband Output (A4)

a. Adjust sweep oscillator at J1, TUNING IN, to supply 2 kHz ±20 Hz.

b. Use oscilloscope and check that the signals at both A4TP2 and A4TP4 are approximately 0.7V p-p (at 2 kHz).

c. Check that signals at both A4TP1 and A4TP3 are 8V p-p (7.5V to 8.5V p-p).

d. Remove power, remove card A4 and extender, and replace card A4 into its socket. Re-apply power.

NOTE

Socket A4 "key" will be replaced later. Card A4 must not be extended while performing steps e. through j.

e. Set instrument on left side (from front) and remove bottom cover.

f. Connect wave analyzer to socket A4 pin K (A4-K) and chassis ground. Adjust wave analyzer for 200-Hz bandwidth, mode switch as desired.

g. Adjust A4R8 and A4R30 for maximum rejection of 98 kHz (LSB), should be -70 dB or more below the 102-kHz carrier.

h. Adjust A4R22 and A4R25 for maximum rejection of 100-kHz signal, should be -60 dB or more below the 102-kHz carrier.

i. Repeat steps g. and h. for maximum rejection of 98-kHz and 100-kHz signals.

j. Check that the cross-modulation products of the following frequencies are 50 dB or more below the 102-kHz carrier: (all frequencies in kHz) 112, 110, 108, 106, 104, 100, 98, 94, 92, 90, 88 and 2.

k. Disconnect wave analyzer, replace instrument bottom cover and set instrument on bottom. Remove power, extend card A4, and re-apply power.

NOTE

Throughout steps l. through r., ensure that the TUNING INPUT signal is constant level; i.e., approximately 0.8V p-p at A5TP2 and A5TP3, as measured in step d. of paragraph 4.2.3.

l. Adjust sweep oscillator at TUNING INPUT for 22 kHz ±20 Hz. Connect oscilloscope to A4TP9.

m. Adjust A4R35 for 2.4V p-p.

n. Adjust A4R48 so TUNING AMPLITUDE meter reads center-scale.

o. Adjust sweep oscillator for 40 kHz ±40 Hz, and adjust A4R49 for 2.4V p-p (140 kHz at A4TP9).

p. Adjust sweep oscillator for 50 Hz ±5 Hz, and adjust A4R37 for 2.4V p-p (100,050 Hz at A4TP9).

q. Repeat steps l. through p. and compensate for any errors due to interaction.

r. Sweep TUNING INPUT with constant level signal from 2 Hz to 50 kHz. TUNING AMPLITUDE meter should read within the green area up to 47 kHz.

s. Remove power, remove card A4 and extender, replace the "key" between pins 12 and 13, and return card A4 to its socket.

Extend card A6 (for next procedure) and then re-apply power. Allow 5-minute warmup.

4.2.6 Carrier Filter (A6)

a. Adjust sweep oscillator at TUNING INPUT for 2 kHz ±20 Hz.

b. Use oscilloscope with probe and check at A6TP1 for 102-kHz signal, approximately 2.4V p-p.

c. Check at A6TP4 for 102-kHz square-wave signal, approximately 2.5V p-p, with duty cycle of 60-40 or better.

d. Monitor A6TP3 and adjust A6R28 for pulse width of approximately 400 nanoseconds (at base). Jitter should be approximately 50 nanoseconds, trailing edge relative to leading edge.

e. Monitor A6TP5 and adjust A6R55 for 2.4V p-p.

f. Connect wave analyzer to A6TP5 and check that all of the following frequencies are 65 dB or more below 102-kHz carrier: 98 kHz, 100 kHz, 110 kHz, and 112 kHz.

g. Remove power, remove card A6 and extender, replace the "key" between pins 10 and 11, and return A6 to its socket.

h. If the instrument is a Model SD1010B-1 (with 65V p-p Carrier Amplifier), replace the bottom cover and perform the calibration procedure given in Instruction Manual Addendum for SD1010B-1 Carrier Generator.

If instrument is a Model SD1010B, remove all test equipment, and replace top and bottom covers. To check for proper overall operation, perform the Operational Checkout Procedure of paragraph 2.2 in Section II of this manual.

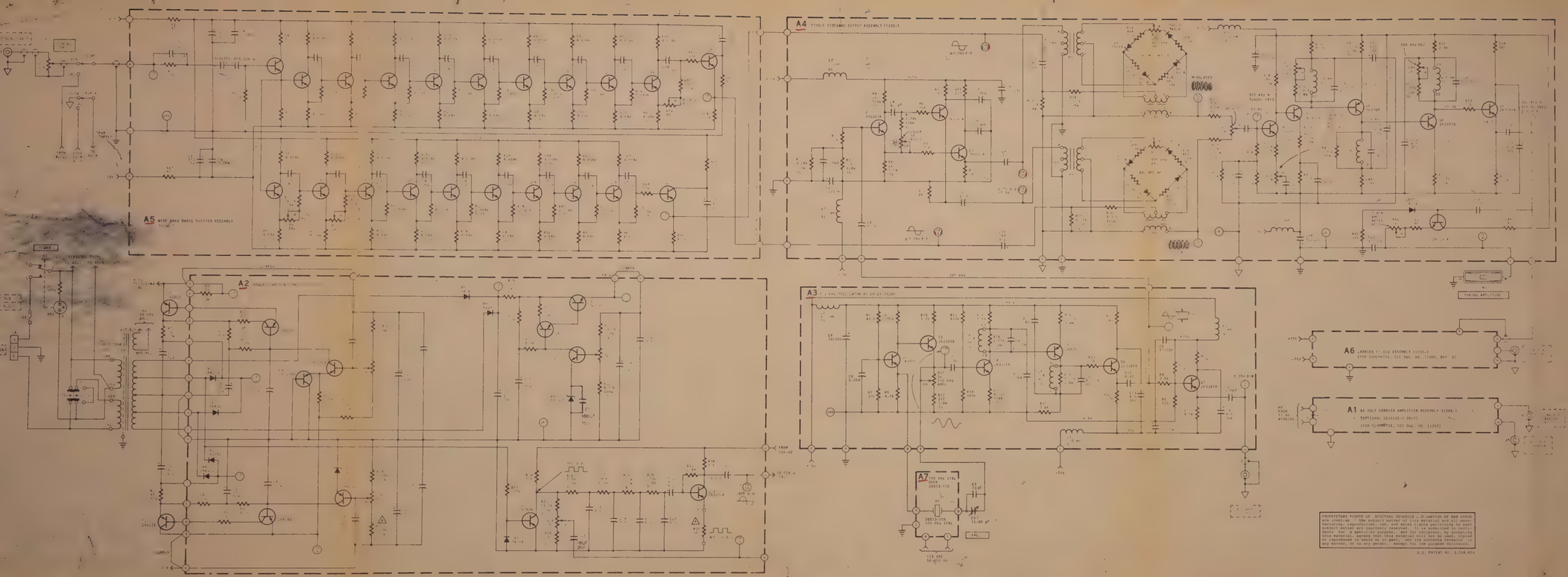
## 4.3 PARTS REPLACEMENT

Except for some special SDC specification-controlled parts listed in Table 4-2, which must be ordered from Spectral Dynamics Corporation, standard electronic parts have been used throughout the instrument. Spectral Dynamics maintains a complete stock of all parts and complete printed circuit card assemblies used in the instrument.

When ordering a replacement part or assembly, be sure to include the reference designation, the part number or manufacturer's designation, and a complete description; include also the instrument name, model number, and serial number.

Table 4-2. Special Replaceable Parts List

| Reference Designator | Description | Part Number Mfr. Designation |
|---|---|---|
| A1 | 65V Carrier Amplifier Assembly (SD1010B-1 only) | 11248-1 |
| A2 | Power Supply Assembly | 10958-1 |
| A3 | 100-kHz Oscillator Assembly | 11200-1 |
| A4 | Single Sideband Assembly | 11220-1 |
| A5 | Wideband Phase Shift Assembly | 10786-1 |
| A6 | Carrier Filter Assembly | 11230-1 |
| A7 | Crystal Oven (less crystal) | 20013-112 |
| Y1 | 100-kHz Crystal | 20013-204 |
| M1 | Meter, TUNING AMPLITUDE | 20013-152 |
| S1 | Switch/Indicator, POWER | 10529000 |
| S2 | Switch, OPER/CAL | 20013-091 |
| T1 | Transformer, Power | 20013-189 |
| | Power Cable | 17258-S Belden |




| REVISIONS | | | | | | |
|---|---|---|---|---|---|---|
| REV. | ECO | S.N. | DESCRIPTION | DRAFT | CHECK | APPV. |
| A | | 011 | Released. | | | |
| B | 5318 | 011<br>015 | Changed value of A4R36, A4R35, A2C2, & A2C4<br>Added A4C27 & designated A2P116 factory set. | | | |
| | | | A2C1 was 4.7μF | | | |
| | | | SEE BTU | | | |

NOTES.

1. UNLESS OTHERWISE SPECIFIED, ALL RESISTANCE VALUES ARE IN OHMS +5%, 1/4W, ALL CAPACITANCE IN MICRO FARAD, ±10%, 200V
2. SYMBOL ▭ INDICATES FRONT PANEL LOCATION.
3. SYMBOL ▭ INDICATES REAR CHASSIS LOCATION.
4. ⚠ FACTORY SELECTED WITH OPTIMUM VALUE SHOWN.
5. ALL PRECISION RESISTORS ARE 1% OR BETTER.
6. ON CIRCUIT CARD A5, ALL TRANSISTORS ARE TYPE 2N3391A.

| HIGHEST REFERENCE USED | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASSY | A | C | CR | D | E | L | M | R | S | TP | Q | V | Y | | |
| 11286-1 | | 27 | | | | | | 69 | | 3 | 21 | | | | |
| 10996-1 | | 6 | 5 | | 2 | | | 35 | | 10 | 13 | | | | |
| 11220-1 | | 2 | 9 | | 6 | | 7 | 55 | | 9 | 9 | 4 | | | |
| 11260-1 | | 13 | | | 8 | | 5 | 22 | | 3 | 6 | | 1 | | |
| 20013-132 | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| INTER CONNECT | 7 | 8 | | 1 | | 1 | 6 | | 1 | 4 | 2 | | 1 | | |

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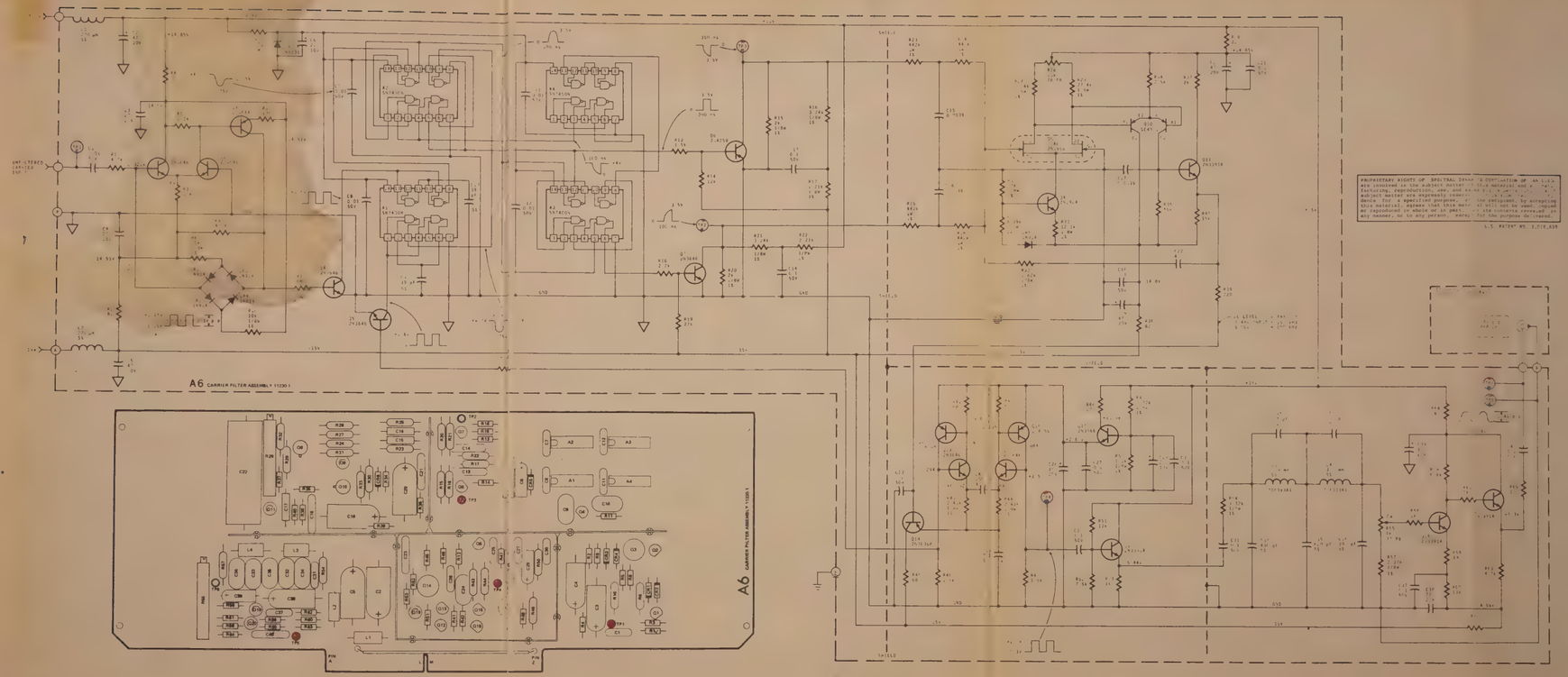
U.S. PATENT NO. 3,518,431

SPECTRAL DYNAMICS CORPORATION OF SAN DIEGO

TITLE: SCHEMATIC –
– Model SD10108/SD10108-1 Carrier Generator

| | | | |
|---|---|---|---|
| DRAWN | S. B. CLARE | SIZE | DRAWING NO. |
| CHECKED | | | 11300 |
| ENGINEER | | SCALE | 7-1-68 |
| APPROVED | | SHEET | 1 OF 3 |

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| | | | ET 3 E1 | | | |

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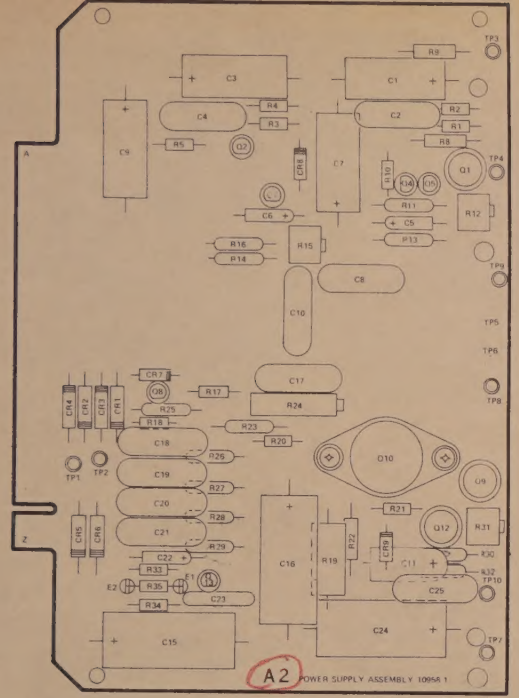
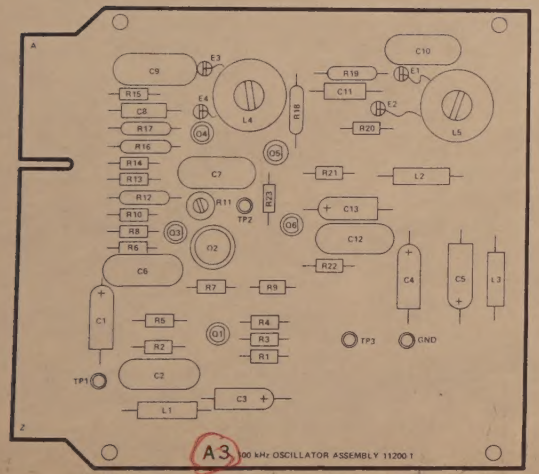
U.S. PATENT NO. 3,518,439

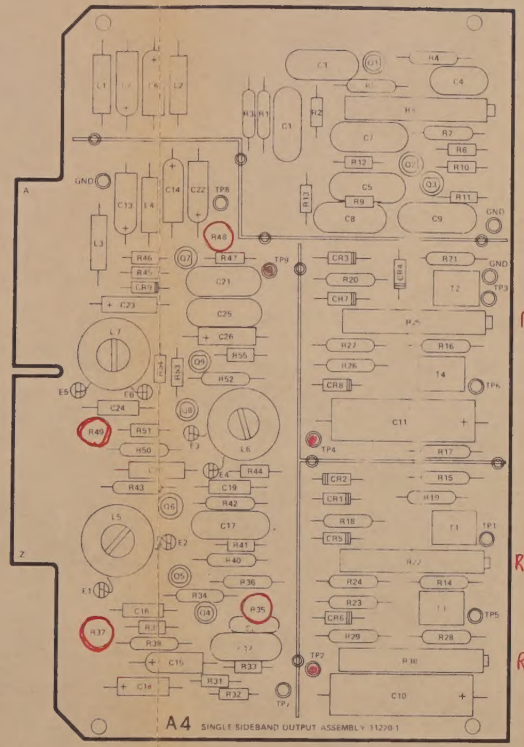
NOTES

1. UNLESS OTHERWISE SPECIFIED, ALL RESISTANCE VALUES ARE IN OHMS, ±5% AND ALL CAPACITANCE VALUES ARE IN MICROFARADS, ± 20%.
2. HIGHEST REF DESIGNATORS OF: A6, C40, CR6, L4, R85, TP4, U21.

| SPECTRAL DYNAMICS CORPORATION OF SAN DIEGO | | | TITLE: SCHEMATIC/COMPONENT LAYOUT — Carrier Filter Assembly 11230-1 Circuit Card A6 Model SD1010B/SD1010B-1 | | |
|---|---|---|---|---|---|
| DRAWN | G. B. CLARE | | SIZE | DRAWING NO | REV |
| ENGINEER | | | | 11300 | |
| APPROVED | | | SCALE | 7-1-68 | SHEET 2 of 3 |

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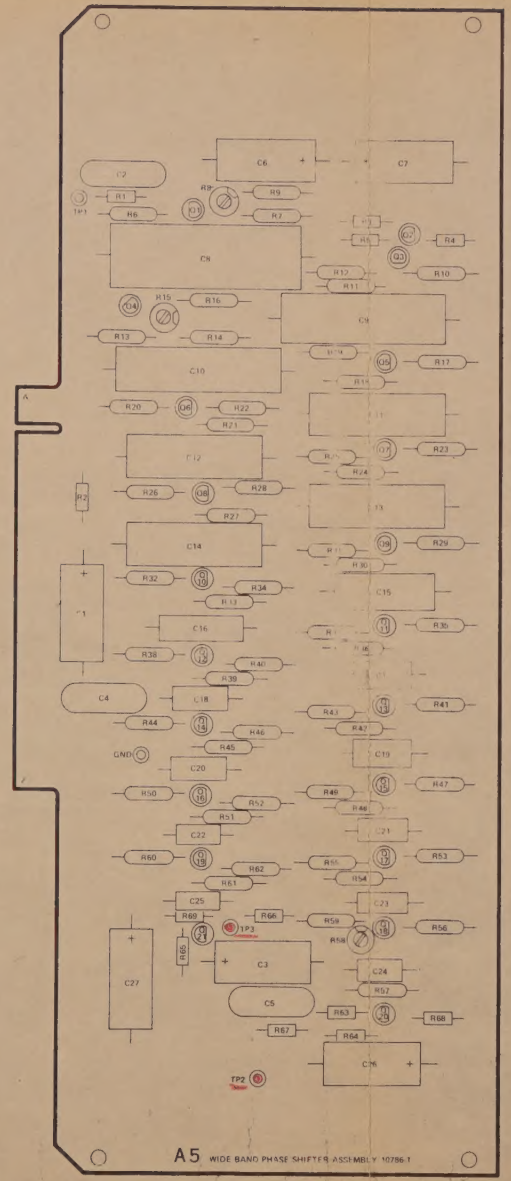
U.S. PATENT NO. 2,816,433




| REVISIONS | | | | | | |
|---|---|---|---|---|---|---|
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| | | | SEE SHEET 1 | | | |

SPECTRAL DYNAMICS CORPORATION OF SAN DIEGO

| | | |
|---|---|---|
| DRAWN | G. B. Clare | |
| CHECKED | | 7-1-68 |
| ENGINEER | | 7-1-68 |
| APPROVED | | 7-2-68 |

TITLE

COMPONENT LAYOUT –
SD1010B Carrier Generator

| SIZE | DRAWING NO. | REV |
|---|---|---|
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SCALE: | 7-1-68 | SHEET 3 OF 3